DOWNLOAD PDF THE OUTER AND MIDDLE EARS

Chapter 1 : Reconstruction of middle ear malformations

The ear is made up of three parts: the outer, middle, and inner calendrierdelascience.com three parts of the ear are important for detecting sound by working together to move sound from the outer part through the middle and into the inner part of the ear.

The outer ear ends at the eardrum, and the middle ear can be seen in the tympanic cavity behind. The human ear consists of three partsâ€"the outer ear , middle ear and inner ear. The middle ear contains the three small bonesâ€"the ossicles â€"involved in the transmission of sound, and is connected to the throat at the nasopharynx , via the pharyngeal opening of the Eustachian tube. The inner ear contains the otolith organsâ€"the utricle and saccule â€"and the semicircular canals belonging to the vestibular system , as well as the cochlea of the auditory system. Outer ear The outer ear is the external portion of the ear and includes the fleshy visible pinna also called the auricle , the ear canal, and the outer layer of the eardrum also called the tympanic membrane. The tragus protrudes and partially obscures the ear canal, as does the facing antitragus. The hollow region in front of the ear canal is called the concha. The first part of the canal is surrounded by cartilage , while the second part near the eardrum is surrounded by bone. This bony part is known as the auditory bulla and is formed by the tympanic part of the temporal bone. The skin surrounding the ear canal contains ceruminous and sebaceous glands that produce protective ear wax. The ear canal ends at the external surface of the eardrum. In some mammals, these muscles can adjust the direction of the pinna. The great auricular nerve , auricular nerve , auriculotemporal nerve , and lesser and greater occipital nerves of the cervical plexus all supply sensation to parts of the outer ear and the surrounding skin. The earlobe consists of areola and adipose tissue. The brain accomplishes this by comparing arrival-times and intensities from each ear, in circuits located in the superior olivary complex and the trapezoid bodies which are connected via pathways to both ears. Middle ear The middle ear The middle ear lies between the outer ear and the inner ear. It consists of an air-filled cavity called the tympanic cavity and includes the three ossicles and their attaching ligaments; the auditory tube ; and the round and oval windows. The ossicles are three small bones that function together to receive, amplify, and transmit the sound from the eardrum to the inner ear. The ossicles are the malleus hammer , incus anvil , and the stapes stirrup. The stapes is the smallest named bone in the body. The middle ear also connects to the upper throat at the nasopharynx via the pharyngeal opening of the Eustachian tube. The malleus receives vibrations from sound pressure on the eardrum, where it is connected at its longest part the manubrium or handle by a ligament. It transmits vibrations to the incus, which in turn transmits the vibrations to the small stapes bone. The wide base of the stapes rests on the oval window. As the stapes vibrates, vibrations are transmitted through the oval window, causing movement of fluid within the cochlea. As the stapes pushes the secondary tympanic membrane , fluid in the inner ear moves and pushes the membrane of the round window out by a corresponding amount into the middle ear. The ossicles help amplify sound waves by nearly 15â€"20 times. Inner ear The inner ear sits within the temporal bone in a complex cavity called the bony labyrinth. A central area known as the vestibule contains two small fluid-filled recesses, the utricle and saccule. These connect to the semicircular canals and the cochlea. There are three semicircular canals angled at right angles to each other which are responsible for dynamic balance. The cochlea is a spiral shell-shaped organ responsible for the sense of hearing. These structures together create the membranous labyrinth. The inner ear structurally begins at the oval window, which receives vibrations from the incus of the middle ear. Vibrations are transmitted into the inner ear into a fluid called endolymph , which fills the membranous labyrinth. The endolymph is situated in two vestibules, the utricle and saccule , and eventually transmits to the cochlea, a spiral-shaped structure. The cochlea consists of three fluid-filled spaces: The outer ear is supplied by a number of arteries. The posterior auricular artery provides the majority of the blood supply. The anterior auricular arteries provide some supply to the outer rim of the ear and scalp behind it. The posterior auricular artery is a direct branch of the external carotid artery, and the anterior auricular arteries are branches from the superficial temporal artery. The occipital artery also plays a role. Other arteries which are present but play a smaller role include branches of the middle meningeal artery , ascending pharyngeal artery , internal carotid artery , and the artery of the pterygoid canal. Hearing Sound waves travel through the outer ear, are modulated by the middle ear, and are transmitted to the vestibulocochlear nerve in the inner ear. This nerve transmits information to the temporal lobe of the brain, where it is registered as sound. Sound that travels through the outer ear impacts on the eardrum, and causes it to vibrate. The three ossicles bones transmit this sound to a second window the oval window which protects the fluid-filled inner ear. In detail, the pinna of the outer ear helps to focus a sound, which impacts on the eardrum. The malleus rests on the membrane, and receives the vibration. This vibration is transmitted along the incus and stapes to the oval window. Two small muscles, the tensor tympani and stapedius , also help modulate noise. The two muscles reflexively contract to dampen excessive vibrations. Vibration of the oval window causes vibration of the endolymph within the vestibule and the cochlea. The hollow channels of the inner ear are filled with liquid, and contain a sensory epithelium that is studded with hair cells. The microscopic "hairs" of these cells are structural protein filaments that project out into the fluid. The hair cells are mechanoreceptors that release a chemical neurotransmitter when stimulated. Sound waves moving through fluid flows against the receptor cells of the organ of Corti. The fluid pushes the filaments of individual cells; movement of the filaments causes receptor cells to become open to receive the potassium -rich endolymph. This causes the cell to depolarise, and creates an action potential that is transmitted along the spiral ganglion , which sends information through the auditory portion of the vestibulocochlear nerve to the temporal lobe of the brain. Balance ability and Equilibrioception Providing balance, when moving or stationary, is also a central function of the ear. The ear facilitates two types of balance: Static balance is provided by two ventricles, the utricle and the saccule. Cells lining the walls of these ventricles contain fine filaments, and the cells are covered with a fine gelatinous layer. Each cell has 50â€”70 small filaments, and one large filament, the kinocilium. Within the gelatinous layer lie otoliths , tiny formations of calcium carbonate. When a person moves, these otoliths shift position. This shift alters the positions of the filaments, which opens ion channels within the cell membranes, creating depolarisation and an action potential that is transmitted to the brain along the vestibulocochlear nerve. These three canals are orthogonal at right angles to each other. At the end of each canal is a slight enlargement, known as the ampulla , which contains numerous cells with filaments in a central area called the cupula. The fluid in these canals rotates according to the momentum of the head. When a person changes acceleration, the inertia of the fluid changes. This affects the pressure on the cupula, and results in the opening of ion channels. This causes depolarisation, which is passed as a signal to the brain along the vestibulocochlear nerve. Development During embryogenesis the ear develops as three distinct structures: After implantation, around the second to third week the developing embryo consists of three layers: Each otic placode recedes below the ectoderm, forms an otic pit and then an otic vesicle. Closer to the back of the embryo, they form what will become the utricle and semicircular canals. Closer to the front of the embryo, the vesicles differentiate into a rudimentary saccule, which will eventually become the saccule and cochlea. Part of the saccule will eventually give rise and connect to the cochlear duct. This duct appears approximately during the sixth week and connects to the saccule through the ductus reuniens. The scala media contains endolymph. The nerve begins to form around the 28th day. Shh is secreted by the notochord. This develops as a structure called the tubotympanic recess. The first two malleus and incus derive from the first pharyngeal arch and the stapes derives from the second. Unlike structures of the inner and middle ear, which develop from pharyngeal pouches, the ear canal originates from the dorsal portion of the first pharyngeal cleft. The pinna originates as a fusion of six hillocks. The first three hillocks are derived from the lower part of the first pharyngeal arch and form the tragus, crus of the helix, and helix, respectively. The final three hillocks are derived from the upper part of the second pharyngeal arch and form the antihelix, antitragus, and earlobe. As the mandible forms they move towards their final position level with the eyes.

Chapter 2 : Human ear - Transmission of sound waves through the outer and middle ear | calendrierdelaso

The anatomy of the outer and inner ear Our ears are among the most complex organs. The ear is composed of four general areas that pick up sound waves and translate them into sounds in our brain.

Mechanisms of Hearing The ear is comprised of three portions: The outer external ear consists of an auricle and ear canal. These structures gather the sound and direct it toward the ear drum tympanic membrane. The middle ear chamber lies between the external and inner ear. This chamber is connected to the back of the throat pharynx by the eustachian tube which serves as a pressure equalizing valve. The middle ear consists of an eardrum and three small ear bones ossicles: These structures transmit sound vibrations to the inner ear. A disturbance of the eustachian tube, eardrum or the ear bones may result in a conductive hearing impairment. This type of impairment is usually corrected medically or surgically. Function of the Eustachian Tube The eustachian tube is a narrow channel which connects the middle ear with the nasopharynx the upper throat area just above the palate, in back of the nose. The narrowest portion is that area near the middle ear space. The eustachian tube functions as a pressure equalizing valve of the middle ear, which is normally filled with air. Under normal circumstances the eustachian tube opens for a fraction of a second in response to swallowing or yawning. In so doing it allows air into the middle ear to replace air that has been absorbed by the middle ear lining mucous membrane or to equalize pressure changes occurring with altitude changes. Anything that interferes with this periodic opening and closing of the eustachian tube may result in a hearing impairment or other ear symptoms. Obstruction or blockage of the eustachian tube results in a negative middle ear pressure, with restraction sucking in of the eardrum tympanic membrane. In an adult this is usually accompanied by some discomfort, such as a fullness or pressure feeling, and may result in a mild hearing impairment and head noise tinnitus. In children there may be no symptoms. If the obstruction is prolonged, the fluid may be sucked in from the mucous membrane in the middle ear creating a condition called serous otitis media fluid in the middle ear. This occurs frequently in children in connection with an upper respiratory infection or allergies and accounts for the hearing impairment associated with this condition. On occasion just the opposite from blockage occurs; the tube remains open for a prolonged period. This is called abnormal patency of the eustachian tube patalous eustachian tube. This is less common than serous otitis media and occurs primarily in adults. Because the tube is constantly open the patient may hear himself breathe and hears his voice reverberate in the affected ear. Fullness and a blocked feeling are not uncommon sensations experienced by the patient. Abnormal patency of the eustachian tube is annoying but does not produce a hearing impairment. Eustachian Tube and Problems Related to Flying Individuals with a eustachian tube problem may experience difficulty equalizing middle ear pressure when flying. When an aircraft ascends, the atmospheric pressure decreases, resulting in a relative increase in the middle ear air pressure. When the aircraft descends, just the opposite occurs; atmospheric pressure increases in the cabin of the aircraft and there is a relative decrease in the middle ear pressure. Either situation may result in discomfort in the ear due to abnormal middle ear pressure compared to the cabin pressure, if the eustachian tube is not functioning properly. Usually, this discomfort is experienced upon descent of the aircraft. To avoid middle ear problems associated with flying you should not fly if you have an acute upper respiratory problem such as a common cold, allergy attack or sinus infection. This will help suck excess air pressure out of the middle ear. Chew gum to stimulate swallowing. This will blow air up the eustachian tube into the middle ear Valsalva Maneuver. Serious Otitus Media Serous otitis media is a term which is used to describe a collection of fluid in the middle ear. This may be a recent onset acute or may be long standing chronic. Serous otitis media is the most common cause of hearing loss in children. Fortunately, the hearing loss associated with this condition usually is not permanent. However, serous otitis media may be present without recurrent ear infections and a mild hearing loss may be the only sign of its presence. Prompt Audiological identification of the hearing loss and Medical intervention, usually restore hearing to normal or near normal levels. Serous Otitis Media is quite common in young children. Although the hearing involvement that ocurrs as a consequence is rarely severe, left over a long period of time, has been known to cause or exacerbate speech and language delays. Again prompt identification and intervention are advised. Acute serous otitis media is usually the result of blockage of the eustachian tube from an upper respiratory infection or an attack of nasal allergy. In the presence of bacteria this fluid may become infected leading to an acute suppurative otitis media infected or abscessed middle ear. This chronic condition is usually associated with a hearing impairment. There may be recurrent ear pain, especially when the individual catches a cold. Serous otitis may persist for many years without producing any permanent damage to the middle ear mechanism. Presence of fluid in the middle ear, however, makes it very susceptible to recurrent acute infections. These recurrent infections may result in middle ear damage. Cause of Serious Otitus Media Serous otitis media may result from any condition that interferes with the periodic opening and closing of the eustachian tube. The causes may be congenital present at birth , may be due to infection or allergy, or may be due to mechanical blockage of the tube. The Immature Eustachian Tube The size and shape of the eustachian tube is different in children than in adults. This accounts for the fact that serous otitis media is more common in very young children. Some children inherit a small eustachian tube from their parents; this accounts in part for the familial tendency to middle ear infection. As the child matures, the eustachian tube usually assumes a more adult shape Infection The lining membrane mucous membrane of the middle ear and eustachian tube is connected with, and is the same as, the membrane of the nose, sinuses and throat. Infection of these areas results in the mucous membrane swelling, which in turn may result in eustachian tube obstruction. Allergy Allergic reaction in the nose and throat result in swelling of the mucous membranes and this swelling may also affect the eustachian tube. This reaction may be acute or chronic. Acute Serious Otitus Media Treatment of acute serous otitis media is medical, and is directed towards treatment of the upper respiratory infection or allergy attacks. This may include antibiotics, antihistamines anti-allergy drugs , decongestants drugs to decrease mucous membrane swelling and nasal sprays. This results in what is commonly called an abscessed ear or an infected middle ear. This infected fluid pus in the middle ear may cause severe pain. If the audiological and medical evaluations reveal there is considerable ear pressure, a myringotomy incision of the eardrum membrane may be necessary to relieve the pressue, drainage, and the pain. In many instances antibiotic treatment will suffice. The pressure equalization tube inserted usually stays in and open for months and then is naturally pushed out be healing processes in the ear. Chronic Serious Otitus Media Treatment of chronic serous otitis media may either be medical or surgical. As the acute upper respiratory infection subsides, it may leave the patient with a persistent eustachian tube blockage. Antibiotic treatment may be indicated. Allergy is often a major factor in the development or persistence of serous otitis media. Mild cases can be treated with antihistaminic drugs. Again, the insertion of a ventilation tube is indicated when the ears are not responsive to pharmacological treatment. The ventilation tube temporarily takes the place of the eustachian tube in equalizing middle ear pressure. Usually the chonic condition resolves while the tube is in place, not requiring the re-insertion of an additional tube. In adults, a myringotomy and insertion of a ventilation tube is usually performed in the office under local anesthesia, with the use of a topical solution placed on top of the tympanic membrane. In children, general anesthesia is required. When a ventilation tube is in place, a patient may carry on normal activities with the exception that no water must enter the ear canal. Often this can be prevented with vaseline on a cotton ball or a silicone ear plug. In addition, a custom made ear-mold, made by the Audiologist, will often prevent water from entering the ear canal. Although the discomfort which often accompanies middle ear and Eustachian Tube maladies often will bring an adult straight to a Physician, sometimes, especially with children, there is no discomfort. With them, often, the only way to know of a middle ear or Eustachian Tube discorder is from a louder T. Even before a hearing loss presents itself, tympanometry may be the most sensitive diagnostic test for middle ear and Eustachian Tube disorders. With tympanometry see Services section for more details the Audiologist inserts a small probe to the outside of the ear canal for 5 seconds. If too much sound energy is reflected back to the probe, fluid in the middle ear cavity, due to one of the above reasons, is suspected. Also, tymanometry can read whether the ear drum is drawn in due to negative middle ear pressure, an often times precursor to middle ear fluid. Even after ventilation tubes P. Tubes are inserted, hearing tests are important to monitor and substantiate the improved hearing. Moreover, the tympanometry can verify that the P. Tubes are still functional.

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Chapter 3 : The middle ear â€“ parts and functions of the middle ear | Anatomy

The middle ear is the part of the ear between the eardrum and the oval window. The middle ear transmits sound from the outer ear to the inner ear. The middle ear consists of three bones: the hammer (malleus), the anvil (incus) and the stirrup (stapes), the oval window, the round window and the Eustrachian tube.

Ossicles[edit] The middle ear contains three tiny bones known as the ossicles: The ossicles were given their Latin names for their distinctive shapes; they are also referred to as the hammer, anvil, and stirrup, respectively. The ossicles directly couple sound energy from the ear drum to the oval window of the cochlea. While the stapes is present in all tetrapods , the malleus and incus evolved from lower and upper jaw bones present in reptiles. The ossicles are classically supposed to mechanically convert the vibrations of the eardrum , into amplified pressure waves in the fluid of the cochlea or inner ear with a lever arm factor of 1. Since the effective vibratory area of the eardrum is about 14 fold larger than that of the oval window, the sound pressure is concentrated, leading to a pressure gain of at least The eardrum is merged to the malleus, which connects to the incus, which in turn connects to the stapes. Vibrations of the stapes footplate introduce pressure waves in the inner ear. There is a steadily increasing body of evidence that shows that the lever arm ratio is actually variable, depending on frequency. The eardrum is actually attached to the malleus handle over about a 0. The linear attachment of the eardrum to the malleus actually smooths out this chaotic motion and allows the ear to respond linearly over a wider frequency range than a point attachment. The auditory ossicles can also reduce sound pressure the inner ear is very sensitive to overstimulation , by uncoupling each other through particular muscles. Stapedius muscle and Tensor tympani The movement of the ossicles may be stiffened by two muscles. The stapedius muscle , the smallest skeletal muscle in the body, connects to the stapes and is controlled by the facial nerve ; the tensor tympani muscle connects to the base of the malleus and is under the control of the medial pterygoid nerve which is a branch of the mandibular nerve of the trigeminal nerve. These muscles contract in response to loud sounds, thereby reducing the transmission of sound to the inner ear. This is called the acoustic reflex. Nerves[edit] Of surgical importance are two branches of the facial nerve that also pass through the middle ear space. These are the horizontal portion of the facial nerve and the chorda tympani. Damage to the horizontal branch during ear surgery can lead to paralysis of the face same side of the face as the ear. The chorda tympani is the branch of the facial nerve that carries taste from the ipsilateral half same side of the tongue. Sound transfer[edit] Ordinarily, when sound waves in air strike liquid, most of the energy is reflected off the surface of the liquid. The middle ear allows the impedance matching of sound traveling in air to acoustic waves traveling in a system of fluids and membranes in the inner ear. This system should not be confused, however, with the propagation of sound as compression waves in liquid. The middle ear couples sound from air to the fluid via the oval window , using the principle of "mechanical advantage" in the form of the "hydraulic principle" and the "lever principle". The collected pressure of sound vibration that strikes the tympanic membrane is therefore concentrated down to this much smaller area of the footplate, increasing the force but reducing the velocity and displacement, and thereby coupling the acoustic energy. The middle ear is able to dampen sound conduction substantially when faced with very loud sound, by noise-induced reflex contraction of the middle-ear muscles. Clinical significance[edit] The middle ear is hollow. In a high-altitude environment or on diving into water, there will be a pressure difference between the middle ear and the outside environment. This pressure will pose a risk of bursting or otherwise damaging the tympanum if it is not relieved. One of the functions of the Eustachian tubes that connect the middle ear to the nasopharynx is to help keep middle ear pressure the same as air pressure. The Eustachian tubes are normally pinched off at the nose end, to prevent being clogged with mucus , but they may be opened by lowering and protruding the jaw; this is why yawning or chewing helps relieve the pressure felt in the ears when on board an aircraft. Otitis media is an inflammation of the middle ear. Other animals[edit] The middle ear of tetrapods is analogous with the spiracle of fishes, an opening from the pharynx to the side of the head in front of the main gill slits. In fish embryos, the spiracle forms as a pouch in the pharynx, which grows outward and breaches the skin to form an opening; in most tetrapods, this breach is never quite completed, and the final vestige of tissue separating it from the outside world becomes the eardrum. The inner part of the spiracle, still connected to the pharynx, forms the eustachian tube. This is connected indirectly with the eardrum via a mostly cartilaginous extracolumella and medially to the inner-ear spaces via a widened footplate in the fenestra ovalis. The structure of the middle ear in living amphibians varies considerably, and is often degenerate. In most frogs and toads , it is similar to that of reptiles, but in other amphibians, the middle ear cavity is often absent. In these cases, the stapes either is also missing or, in the absence of an eardrum, connects to the quadrate bone in the skull, although, it is presumed, it still has some ability to transmit vibrations to the inner ear. In many amphibians, there is also a second auditory ossicle, the operculum not to be confused with the structure of the same name in fishes. This is a flat, plate-like bone, overlying the fenestra ovalis, and connecting it either to the stapes or, via a special muscle, to the scapula. It is not found in any other vertebrates. Functionally, the mammalian middle ear is very similar to the single-ossicle ear of non-mammals, except that it responds to sounds of higher frequency, because these are better taken up by the inner ear which also responds to higher frequencies than those of non-mammals. The malleus, or "hammer", evolved from the articular bone of the lower jaw, and the incus, or "anvil", from the quadrate. In other vertebrates, these bones form the primary jaw joint, but the expansion of the dentary bone in mammals led to the evolution of an entirely new jaw joint, freeing up the old joint to become part of the ear. For a period of time, both jaw joints existed together, one medially and one laterally. The evolutionary process leading to a three-ossicle middle ear was thus an "accidental" byproduct of the simultaneous evolution of the new, secondary jaw joint. In many mammals, the middle ear also becomes protected within a cavity, the auditory bulla , not found in other vertebrates. A bulla evolved late in time and independently numerous times in different mammalian clades, and it can be surrounded by membranes, cartilage or bone. The bulla in humans is part of the temporal bone.

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Chapter 4 : Ear - Wikipedia

The outer ear collects acoustic energy arriving at the head and funnels or directs the energy to the middle ear, which it is transformed into _____. ear canal resonance The most prominent enchancement of the acoustic signal is the direct result of the ___________, which provides more resonance than the pinna effect.

This condition can cause a great degree of discomfort and distress to the affected animal. In ferrets, the symptoms of ear canal inflammation can be particularly pronounced and if left untreated can become dangerous not only to the hearing of the animal but also potentially to its life. Book First Walk Free! Dark Wax A ferret suffering from inflammation of the ear will often exhibit a change in the color of its ear wax. Owners will be able to see the wax becoming much darker than usual, even to the point of taking on a brownish tinge. Additionally, the quantity of wax will substantially increase, with wax being visible even to cursory observation. Pain Ferrets with inflammation of the outer and middle ear will also show signs of pain as the condition progresses. Typically, they will start becoming withdrawn and unwilling to interact with other members of the household and may even display a reduced appetite. They may also become aggressive if their owner attempts to touch their ears, due to the extreme sensitivity that they may be experiencing. The dark crust that forms is a tell-tale sign of an ear problem, and should prompt an immediate visit to the vet. Furthermore, this crust can often be found to emit a foul odor, which is a good signifier of a bacterial infection. Scratching at the Ears Irritation and inflammation of the ear canal can provoke an itching sensation for the affected ferret. In an effort to make it stop, they may start scratching excessively at the area around their ears. The ferret may also start shaking its head seemingly at random in an effort to relieve the irritation felt in the inaccessible middle ear. Causes of Inflammation of the Middle and Outer Ear Canal in Ferrets There are three main causes for inflammation of the middle and outer ear that are commonly seen in ferrets: Bacteria can often build up in the ear due to its relatively warm and moist environment. Most of the time this is not an issue and the bacteria is simply moved out of the ear canal by the wax. But in some cases, the bacteria can take hold and start to attack the ear itself. In such an event, the body will attempt to protect itself in order to remove the bacteria, thereby causing the overproduction of wax and irritation described above. Ear mites will often try to make their home in the outer ear for easy access to dead skin cells, and their activities can also cause a large amount of irritation as they move across the skin. Abnormal growths, however, are mostly confined to the middle and inner ear, though their presence can put pressure on the other sensitive structures of the ear. Diagnosis of Inflammation of the Middle and Outer Ear Canal in Ferrets When the ferret is brought to the clinic, the vet will usually perform a standard physical examination. In most cases, they will be able to make a diagnosis of bacterial infection or mite activity at this stage, though they may wish to take a sample of earwax for viewing under a microscope just to be sure. To examine a growth in the middle ear, however, the vet may wish to use an imaging scan such as ultrasound to gauge its location and composition. Treatment of Inflammation of the Middle and Outer Ear Canal in Ferrets The vast majority of ear infections can be treated via the use of a simple topical antibacterial drug. Mites are also killed using topical poisons and shampoos, though they have a greater chance of returning due to the resilience of their eggs, which can hatch several weeks later, requiring more treatments. Recovery of Inflammation of the Middle and Outer Ear Canal in Ferrets The majority of bacterial infections and mite infestations can be resolved within the space of three to four weeks if the medication is administered correctly at the right intervals. Surgery may take more time to fully recover from, depending on the size of the required incision. Owners should also keep in mind the necessity to maintain a clean living space for the ferret to prevent secondary infections in the aftermath of surgery and to prevent mites that may have settled on bedding materials from re-infesting the animal.

Chapter 5 : Conductive Hearing Loss - Damage in the outer or middle ear

Both of my ears (one more severe than the other) have outer and middle ear infections. The one ear that is really bad is filled with fluid behind the eardrum, and i feel it in my head, along with the outer canal being so swollen that i cannot fit a qtip in and when the doctor used the otoscope, it was painful.

You are free to copy, distribute and transmit the work, provided the original author and source are credited. This article has been cited by other articles in PMC. Abstract Malformations of the middle ear are classified as minor and major malformations. Minor malformations appear with regular external auditory canal, tympanic membrane and aerated middle ear space. The conducting hearing loss is due to fixation or interruption of the ossicular chain. The treatment is surgical, following the rules of ossiculoplasty and stapes surgery. In major malformations congenital aural atresia there is no external auditory canal and a deformed or missing pinna. The mastoid and the middle ear space may be underdevelopped, the ossicular chain is dysplastic. Surgical therapy is possible in patients with good aeration of the temporal bone, existing windows, a near normal positioned facial nerve and a mobile ossicular chain. Plastic and reconstructive surgery of the pinna should proceed the reconstruction of the external auditory canal and middle ear. In cases of good prognosis unilateral aural atresia can be approached already in childhood. In patients with high risk of surgical failure, bone anchored hearing aids are the treatment of choice. Recent reports of implantable hearing devices may be discussed as an alternative treatment for selected patients. In middle ear malformations normaly the inner ear is intact, the malfunction is due to mechanical problems. According to this the treatment of middle ear malformations always has to be surgical. The minor malformation is treated with established methods of middle ear surgery. Major malformation surgery is the most difficult level in middle ear surgery. Kiesselbach [1] is considered to be the first who seriously attempted atresia treatment. The simple but difficult question, most of the patients are infants, is to recognize if the malformed ear is a hearing ear. Today brainstem audiometry may answer this question at a much higher level of certainty. Crucial for indication in atresia surgery and for favourable results is the high resolution computertomography CT. Out of the CT-scans developped grading systems help to make the results more predictable. Thus inadequate expectations can be avoided. In cases of unfavourable anatomy where classical surgery is not possible, bone-anchored hearing aids BAHA are an established alternative. Recent developments using implantable hearing aids show promising results for further improvement. But there are some aspects of the ontogenetic development, that may be of some interest. Nevertheless one third of patients with middle ear malformations are considered to have a inner ear malformation as well [2], [3]. The auricle is built out of 6 hillocks. The hillocks are dedicated to the first branchial arch mandibular arch and the hillocks to the second branchial arch hyoid arch. In reptiles and birds this part develops not towards the malleus but the joint bone of the lower jaw articulare. This bone connects with the bone of the upper jaw quadratum. In mammals these two bones of the primary mandibular joint articulare, quadratum are missing. Inspite of this two new ossicles exist, malleus and incus, instead of the columella of the sauropsidae. From these studies Reichert and Gaupp [5] developped the theory of homology of primary mandibular joint and sound conducting apparatus. According to this the malleus matches the articulare, the incus the quadratum. Both ossicles originate from the first branchial arch mandubular arch. The stapes is then originating from the hyoid arch 2. The unusual shape of the stapes with two crura arrives from the development around the stapedial artery. According to Otto [6] there is no obvious explanation why the already good functioning columella of the sauropsidae should be replaced. There is also no hint how the columella between tympanic membrane and stapes was replaced by quadratum and articulare without any functional deficiency. Otto supposes that all 3 ossicles derive from the second branchial arch. Analogously he assumes the border between mandibular and hyoid arch between the first and second inspite between the third and sixth hillock. Ear clefts, appendices of the ear up to doubling of the pinna seem to support this objection [7]. Altmanns [9] taxonomy of 3 groups based on the study of temporal bones. He differentiated minor, medium and major malformations. From a clinical standpoint a classification in minor and major malformations is established [10], [11], [12], some authors advice further subclassification [13], [14]. In some cases the ear canal is more narrow as usual and the size of the tympanic membrane reduced. Malformed is the ossicular chain, mostly the stapes, fixed as congenital stapes ankylosis [15]. There is a broad variety of ossicular dysplasia, bony bridges with malleus and incus fixation, fusion of malleus and incus or disruption of the ossicular chain like aplasia of the long process of the incus [16]. In most cases there is a combination with malformations of the auricle of different grade, this may not correlate with the grade of middle ear malformation [17]. The absence of the outer ear canal results in approximation of the temporal mandibular joint towards the mastoid Figure 1 Fig. The os tympanicum may be developped rudimental or totally absent. Laterally to the more or less aerated middle ear space lies the so called atresia plate, a bony condensation product. In animal studies tissues of different origin have been recognized to build up the atresia plate os tympanicum, squama of the temporal bone, hyperplastic labyrinthine capsule [18]. There is a wide range of pneumatization of the mastoid Figure 2 Fig. Typically the ossicles are dysplastic, malleus and incus form a typical conglomerate. In most cases a normal and mobile stapes exists. As a rule the handle of the malleus is fixed. The round window is the most constant structure even in extensive malformations. Cremers and coworkers [13], [19] suggested to distinguish a group of malformations with atresia of the medial part of the ear canal only. Many authors advise to seperate severe malformations that should be excluded from reconstructive surgery [17], [19], [20], [21].

Chapter 6 : What to do when ears have outer and middle ear infections?

Human ear - Transmission of sound waves through the outer and middle ear: The outer ear directs sound waves from the external environment to the tympanic membrane. The auricle, the visible portion of the outer ear, collects sound waves and, with the concha, the cavity at the entrance to the external auditory canal, helps to funnel sound into.

Tympanic membrane and middle ear Tympanic membrane The thin semitransparent tympanic membrane , or eardrum, which forms the boundary between the outer ear and the middle ear, is stretched obliquely across the end of the external canal. Its diameter is about 8â€”10 mm about 0. Thus, its outer surface is slightly concave. The edge of the membrane is thickened and attached to a groove in an incomplete ring of bone, the tympanic annulus, which almost encircles it and holds it in place. The uppermost small area of the membrane where the ring is open, the pars flaccida, is slack, but the far greater portion, the pars tensa, is tightly stretched. The appearance and mobility of the tympanic membrane are important for the diagnosis of middle-ear disease, which is especially common in young children. When viewed with the otoscope, the healthy membrane is translucent and pearl-gray in colour, sometimes with a pinkish or yellowish tinge. The tympanic membrane eardrum and auditory ossicles vibrating inside a human ear. The entire tympanic membrane consists of three layers. The outer layer of skin is continuous with that of the external canal. The inner layer of mucous membrane is continuous with the lining of the tympanic cavity of the middle ear. Between these layers is a layer of fibrous tissue made up of circular and radial fibres that give the membrane its stiffness and tension. The membrane is well supplied with blood vessels and sensory nerve fibres that make it acutely sensitive to pain. Middle-ear cavity The cavity of the middle ear is a narrow air-filled space. A slight constriction divides it into an upper and a lower chamber, the tympanum tympanic cavity proper below and the epitympanum above. These chambers are also referred to as the atrium and the attic, respectively. The middle-ear space roughly resembles a rectangular room with four walls, a floor, and a ceiling. The outer lateral wall of the middle-ear space is formed by the tympanic membrane. The ceiling superior wall is a thin plate of bone that separates the middle-ear cavity from the cranial cavity and brain above. The floor inferior wall is also a thin bony plate, in this case separating the middle-ear cavity from the jugular vein and the carotid artery below. The back posterior wall partly separates the middle-ear cavity from another cavity, the mastoid antrum, but an opening in this wall leads to the antrum and to the small air cells of the mastoid process , which is the roughened, slightly bulging portion of the temporal bone just behind the external auditory canal and the auricle. In the front anterior wall is the opening of the eustachian tube or auditory tube , which connects the middle ear with the nasopharynx. The inner medial wall, which separates the middle ear from the inner ear , or labyrinth, is a part of the bony otic capsule of the inner ear. It has two small openings, or fenestrae, one above the other. The upper one is the oval window , which is closed by the footplate of the stapes. The lower one is the round window , which is covered by a thin membrane. Auditory ossicles Crossing the middle-ear cavity is the short ossicular chain formed by three tiny bones that link the tympanic membrane with the oval window and inner ear. From the outside inward they are the malleus hammer , the incus anvil , and the stapes stirrup. The malleus more closely resembles a club than a hammer, and the incus looks more like a premolar tooth with uneven roots than an anvil. These bones are suspended by ligaments , which leave the chain free to vibrate in transmitting sound from the tympanic membrane to the inner ear. The auditory ossicles of the middle ear and the structures surrounding them. The malleus consists of a handle and a head. The handle is firmly attached to the tympanic membrane from the centre umbo to the upper margin. The head of the malleus and the body of the incus are joined tightly and are suspended in the epitympanum just above the upper rim of the tympanic annulus, where three small ligaments anchor the head of the malleus to the walls and roof of the epitympanum. Another minute ligament fixes the short process crus of the incus in a shallow depression, called the fossa incudis, in the rear wall of the cavity. The long process of the incus is bent near its end and bears a small bony knob that forms a loose ligament-enclosed joint with the head of the stapes. The stapes is the smallest bone in the body. It is about 3 mm 0. It lies almost horizontally, at right angles to the process of the incus. Its base, or footplate, fits nicely in the oval window and is surrounded by the elastic annular ligament, although it remains free to vibrate in transmitting sound to the labyrinth. Muscles Two minuscule muscles are located in the middle ear. The longer muscle , called the tensor tympani , emerges from a bony canal just above the opening of the eustachian tube and runs backward and then outward as it changes direction in passing over a pulleylike projection of bone. The tendon of this muscle is attached to the upper part of the handle of the malleus. When contracted, the tensor tympani tends to pull the malleus inward and thus maintains or increases the tension of the tympanic membrane. The shorter, stouter muscle, called the stapedius , arises from the back wall of the middle-ear cavity and extends forward and attaches to the neck of the head of the stapes. Its reflex contractions tend to tip the stapes backward, as if to pull it out of the oval window. Thus, it selectively reduces the intensity of sounds entering the inner ear, especially those of lower frequency. Nerves The seventh cranial nerve, called the facial nerve , passes by a somewhat circuitous route through the facial canal in the petrous portion of the temporal bone on its way from the brainstem to the muscles of expression of the face. A small but important branch, the chorda tympani nerve , emerges from the canal into the middle-ear cavity and runs forward along the inner surface of the pars tensa of the membrane, passing between the handle of the malleus and the long process of the incus. Since at this point it is covered only by the tympanic mucous membrane, it appears to be quite bare. Then it resumes its course through the anterior bony wall, bringing sensory fibres for taste to the anterior two-thirds of the tongue and parasympathetic secretory fibres to salivary glands. Eustachian tube The eustachian tube , about 31â€”38 mm 1. At its upper end the tube is narrow and surrounded by bone. Nearer the pharynx it widens and becomes cartilaginous. Its mucous lining , which is continuous with that of the middle ear, is covered with cilia, small hairlike projections whose coordinated rhythmical sweeping motions speed the drainage of mucous secretions from the tympanum to the pharynx. The eustachian tube helps ventilate the middle ear and maintain equal air pressure on both sides of the tympanic membrane. The tube is closed at rest and opens during swallowing so that minor pressure differences are adjusted without conscious effort. During an underwater dive or a rapid descent in an airplane, the tube may remain tightly closed. The discomfort that is felt as the external pressure increases can usually be overcome by attempting a forced expiration with the mouth and nostrils held tightly shut. This maneuver, which raises the air pressure in the pharynx and causes the tube to open, is called the Valsalva maneuver, named for Italian physician-anatomist Antonio Maria Valsalva â€” , who recommended it for clearing pus from an infected middle ear.

Chapter 7 : Middle ear - Wikipedia

Know Your Ears - The Outer And Middle Ear. Sound travels a long way until we finally consciously perceive it. Even after arriving at our ears, it is converted, transformed and decoded multiple times.

Maybe the sound you heard was as quiet as your cat licking her paws. Or maybe it was loud, like a siren going by. Sounds are everywhere, and you have two cool parts on your body that let you hear them all: Your ears are in charge of collecting sounds, processing them, and sending sound signals to your brain. The ear is made up of three different sections: These parts all work together so you can hear and process sounds. Catch the Wave The outer ear is called the pinna or auricle say: This is the part of the ear that people can see. The outer ear also includes the ear canal, where wax is produced. Earwax is that gunky stuff that protects the canal. Earwax contains chemicals that fight off infections that could hurt the skin inside the ear canal. It also collects dirt to help keep the ear canal clean. Good Vibrations After sound waves enter the outer ear, they travel through the ear canal and make their way to the middle ear. To do this, it needs the eardrum, which is a thin piece of skin stretched tight like a drum. The eardrum separates the outer ear from the middle ear and the ossicles say: They are the three tiniest, most delicate bones in your body. MAH-lee-us , which is attached to the eardrum and means "hammer" in Latin the incus say: IN-kus , which is attached to the malleus and means "anvil" in Latin the stapes say: STAY-peez , the smallest bone in the body, which is attached to the incus and means "stirrup" in Latin When sound waves reach the eardrum, they cause the eardrum to vibrate. When the eardrum vibrates, it moves the tiny ossicles â€" from the hammer to the anvil and then to the stirrup. These bones help sound move along on its journey into the inner ear. Nerve Signals Start Here Sound comes into the inner ear as vibrations and enters the cochlea say: KAH-klee-uh , a small, curled tube in the inner ear. The cochlea is filled with liquid, which is set into motion, like a wave, when the ossicles vibrate. The cochlea is also lined with tiny cells covered in tiny hairs that are so small you would need a microscope to see them. When sound reaches the cochlea, the vibrations sound cause the hairs on the cells to move, creating nerve signals that the brain understands as sound. The brain puts it together and hooray! You hear your favorite song on the radio. They keep you balanced, too. In the inner ear, there are three small loops above the cochlea called semicircular canals. Like the cochlea, they are also filled with liquid and have thousands of microscopic hairs. When you move your head, the liquid in the semicircular canals moves, too. The liquid moves the tiny hairs, which send a nerve message to your brain about the position of your head. In less than a second, your brain sends messages to the right muscles so that you keep your balance. To understand this, fill a cup halfway with water. Now move the cup around in a circle in front of you and then stop. Notice how the water keeps swishing around, even after the cup is still? When you stop spinning or step off the ride, the fluid in your semicircular canals is still moving. Once the fluid in the semicircular canals stops moving, your brain gets the right message and you regain your balance. Three Cheers for the Ears! Your ears take care of you, so take care of them. Protect your hearing by wearing earplugs at loud music concerts and around noisy machinery, like in wood or metal shop at school. Your elbow, of course.

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Chapter 8 : Eustachian Tube and Middle Ear Problems - Ashland Audiology

Ear. The ear is situated bilaterally on the human cranium, at the same level as the nose, bordering the face and the head. It is the motherboard for somatic balance and hearing and consists of the outer, middle and inner ear.

The ear The middle ear What is the middle ear? The middle ear is the part of the ear between the eardrum and the oval window. The middle ear transmits sound from the outer ear to the inner ear. The middle ear consists of three bones: The bones of the middle ear The eardrum is very thin, measures approximately mm in diameter and is stretched by means of small muscles. The pressure from sound waves makes the eardrum vibrate. The vibrations are transmitted further into the ear via three bones in the middle ear: These three bones form a kind of bridge, and the stirrup, which is the last bone that sounds reach, is connected to the oval window. The oval window What is the oval window? The oval window is a membrane covering the entrance to the cochlea in the inner ear. When the eardrum vibrates, the sound waves travel via the hammer and anvil to the stirrup and then on to the oval window. When the sound waves are transmitted from the eardrum to the oval window, the middle ear is functioning as an acoustic transformer amplifying the sound waves before they move on into the inner ear. The pressure of the sound waves on the oval window is some 20 times higher than on the eardrum. The pressure is increased due to the difference in size between the relatively large surface of the eardrum and the smaller surface of the oval window. The same principle applies when a person wearing a shoe with a sharp stiletto heel steps on your foot: The small surface of the heel causes much more pain than a flat shoe with a larger surface would. The round window The round window in the middle ear vibrates in opposite phase to vibrations entering the inner ear through the oval window. In doing so, it allows fluid in the cochlea to move. The Eustachian tube What is the Eustachian tube? The Eustachian tube is also found in the middle ear, and connects the ear with the rearmost part of the palate. The tube opens when you swallow, thus equalising the air pressure inside and outside the ear. In most cases the pressure is equalised automatically, but if this does not occur, it can be brought about by making an energetic swallowing action. The swallowing action will force the tube connecting the palate with the ear to open, thus equalising the pressure. Built-up pressure in the ear may occur in situations where the pressure on the inside of the eardrum is different from that on the outside of the eardrum. If the pressure is not equalised, a pressure will build up on the eardrum, preventing it from vibrating properly. The limited vibration results in a slight reduction in hearing ability. A large difference in pressure will cause discomfort and even slight pain. Built-up pressure in the ear will often occur in situations where the pressure keeps changing, for example when flying or driving in mountainous areas.

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Chapter 9 : Human ear - Tympanic membrane and middle ear | calendrierdelascience.com

- Middle ear, which conveys sound vibrations to the oval window - Internal (inner) ear, which contains the receptors for hearing and for equilibrium Example of Outer Ear.

The ear The outer ear The outer ear is the external part of the ear, which collects sound waves and directs them into the ear. Read about the anatomy, the outer ear parts and the function of the outer ear. The pinna What is the pinna? The pinna is the only visible part of the ear the auricle with its special helical shape. It is the first part of the ear that reacts with sound. The function of the pinna is to act as a kind of funnel which assists in directing the sound further into the ear. Without this funnel the sound waves would take a more direct route into the auditory canal. This would be both difficult and wasteful as much of the sound would be lost making it harder to hear and understand the sounds. The pinna is essential due to the difference in pressure inside and outside the ear. The resistance of the air is higher inside the ear than outside because the air inside the ear is compressed and thus under greater pressure. In order for the sound waves to enter the ear in the best possible way the resistance must not be too high. This is where the pinna helps by overcoming the difference in pressure inside and outside the ear. The pinna functions as a kind of intermediate link which makes the transition smoother and less brutal allowing more sound to pass into the auditory canal meatus. The ear canal â€" the auditory canal Once the sound waves have passed the pinna, they move two to three centimetres into the auditory canal before hitting the eardrum, also known as the tympanic membrane. The function of the ear canal is to transmit sound from the pinna to the eardrum. The eardrum What is the eardrum? The eardrum tympanic membrane , is a membrane at the end of the auditory canal and marks the beginning of the middle ear. The eardrum is extremely sensitive and pressure from sound waves makes the eardrum vibrate. In order to protect the eardrum, the auditory canal is slightly curved making it more difficult for insects, for example, to reach the eardrum. At the same time, earwax cerumen in the auditory canal also helps to keep unwanted materials like dirt, dust and insects out of the ear. In addition to protecting the eardrum, the auditory canal also functions as a natural hearing aid which automatically amplifies low and less penetrating sounds of the human voice. In this way the ear compensates for some of the weaknesses of the human voice, and makes it easier to hear and understand ordinary conversation.